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ABSTRACT
This article provides a structural analysis of corporate interlocks in Germany at the beginning of the 20th century. The main goal is, first, to point out that dense interlocking goes along with a socio-economic concentration process originating in the German Empire, and is "freezing" as a proved institutional solution during the Weimar Republic (Abelshauser, 2005; Streeck et al., 2001). Second, a special contribution is to highlight the mechanism behind the network evolution: multiple interlocking of "preferred" actors, thus, creating a core-periphery structured network. Reconstruction of social forces behind these patterns provides an insight into the diverse opportunity structure gained by core corporations. Results demonstrate that the German variety of economic modernization was not only a macro-phenomenon as aggregation would indicate. Actors were quite differently guided by these macro signals. The specific structure of German interlocks is due to selection processes at the micro-level which finally created a hegemonic network different than expected.

Keywords
Corporate network, economic history, path dependency, social capital

INTRODUCTION

This paper is dealing with the formation of personal interlocks between stock companies from 1896 to 1933. Interlocks belong next to the concentration of ownership and a corporative system of industrial relations to the main features of the German variety of capitalism. Recent studies (Krenn, 2008b; Windolf, 2002; Windolf, 2006;) on the comparison of corporate networks between Germany and the US revealed a set of persisting characteristics: German networks are more dense, centralized to the big financial and industrial enterprises and they have a strong tendency towards elite networks. Our research question is to see if dense interlocking is accompanied by a hegemonic figuration. Do we observe a strongly tied core? And what kind of social capital can be deduced from that?
After some comments on the empirical database we briefly discuss theoretical assumptions and methods applied in the paper. Further on here we will mainly follow two aims: Our first goal is to show the concentration of corporate interlocks during the 1920s. The second aim is to reveal characteristic structural mechanisms and determinants behind the observed formation process.

DATABASE

The data shown is part of result of research funded by the German Research Foundation (DFG). Corporations were selected by a size criterion (minimum amount of stock capital in 1896: 5 million Reichsmark (RM), for all other years 10 million RM). In the next step data which involved beside information on managing directors (CEOs) and board members also individual attributes of firms (e.g. sector) was collected for selected companies from year books on stock corporations (see table notes). Germany has a two-board system by which executive managing organs (= CEOs) are personally split from controlling organs (= board of directors).

Corporations who share at least one director are considered as connected. Corporations which have no director with any other corporation in common are regarded as isolates. Accounting for the German board system interlocks can be divided into 'undirected' board-to-board interlocks and 'directed' CEO-to-board interlocks. Theoretically this difference will be strengthened in order to attribute a stronger influence opportunity to directed relations (see the following section). Table 1 gives an overview on the database.

Year	Corporations	Positions in Corporations	Connected Corporations	Isolates
1896	212	1665	156	56
1914	346	4112	321	25
1928	377	8169	366	11
1933	405	6303	389	16

Table 1: Number of Observations (N)

Source: Hoppenstedt, 1896, 1914, 1928, 1934.

Number of corporations as well as number of positions (board sizes) in both managing and controlling boards increased from 1896 to 1933. This paper is mainly dealing with German interlocks. In certain instances though, data is compared to US interlocks. US companies were likewise selected by size. Sources were equivalent year books (NN, 1900/01a; 1900/01b; 1901; 1914/15a; 1914/15b; 1915; 1928; 1928/29a; 1928/29b).[1]

THEORETICAL BACKGROUND

Some remarks on the theoretical background of this research seem to be necessary. A key concept to describe the bond between economy and society is the notion of institutional embeddedness (Granovetter, 1985; Polanyi, 1944). For a majority of sociologists institutions are the central units for explaining social order (North, 1990). That's because, and thereby we are aware of reanimating an old truism, contingency is as a main distinguishing feature of the social world. Consequently, the outcome of social interactions is underdetermined which causes uncertainty. In most circumstances this turns out to be problematic. Arising "problems" are solved by selecting standard solutions, that is to say, institutions. In order to avoid the functionalist trap, it's important to bear in mind that existing institutions are only undetermined selections out of an unknown number of possible others (Luhmann, 1991). In this regard studying the evolution of social structures gives important insights into the ways in which "history matters": Past selections confine future choices. In a simplified way that's what's meant by path-dependence (see e.g. Thelen, 2003). Looking at social structures of a certain period the institutional choices of the past are among the key explanatory factors. Now, taking into consideration that economic institutions are embedded in a broader frame of societal norms and regulations it's conclusive that those institutions are influenced and mutually shaped by other pre-existing institutions, too.

Current comparative analyses of corporate governance structures basically identify two types of market economies, 'liberal' and 'coordinated' ones (for a detailed discussion on varieties of capitalism see Hall et al., 2001 and Lehmbruch, 2001). They differ in their extent of market regulation. The German model definitely belongs to the type of coordinated market economies. Its characteristics are boiling down to one central theme: the regulation of competition. That is reflected in all sub spheres of the economy (e.g. concentration of corporate ownership, interlocking directorates and strong workholder participation, see Beyer, 2006; Streeck et al., 2003). According to historians the formation of those specific economic institutions started mainly during the period of the German Empire and, is still lining a trajectory till present (Abelshauser, 2005).

The emphasis of the paper is set on the corporate network. In Germany interlocking directorates have become a national institution for long. From a macro perspective this interlocking has been taken as indicator for a high extent of integration of the economy (see above). It's now a specific achievement of the network approach to provide a tool for measuring social structures on the aggregate as well as on the individual level. Individually oriented network theories explain interlocks from a resource dependence resp. control perspective. Thereby, the number of relations of one actor to another is a measure for his social capital (Bourdieu, 1983; Coleman, 1990).

[1] The following table gives an overview on the US database.which has slightly different time points: 1900 instead of 1896 and 1938 instead of 1933. For a detailed analysis on the US case we refer to Windolf (Windolf, 2006).

Year	Corporations	Positions in Corporations	Connected Corporations	Isolates
1900	249	3317	226	23
1914	242	3495	193	49
1928	369	6459	329	40
1938	409	6766	375	34

Table 1 in footnote Error! Main Document Only.**: Number of Observations of US Firms (N)**

The more relevant relations one actor has, the more resources he controls, but also the more socially constrained he is. Interlocking in this sense not only provides an opportunity structure for the exchange of all different sorts of information but also other resources as e.g. the building-up of trust relationships and, in case of directed CEO-to-board ties, the influence and control of one actor over another (Koenig et al., 1979; Mizruchi, 1996). Especially the later gained particular attention in connection with the role of big financial institutions. There's a long theoretical tradition following the assumption that the most relevant resource for corporations is capital. Subsequently, banks are regarded as more powerful actors than any other (Hilferding, 1910). Financial control resp. hegemony models therefore argue that banks institutionalize their influence opportunities through interlocks. No matter what motive finally turns the balance, directed ties are at any rate intentional interlocks.

HYPOTHESES

When looking at corporate interlocks in Germany before 1933 we have two assumptions. On the institutional level we expect an increase in network density paralleling the concentration process in the surrounding economic institutions (path dependence hypothesis). After an already very supportive law tradition during the German Empire, especially, law regulations for corporate ownership during the Weimar Republic facilitated corporate group structures. The key period for the concentration process are the 1920s. That's when we expect a proliferation of interlocks, too.
On the individual level we assume a non-random distribution of ties providing a subgroup of preferred actors with a substantial amount of social capital (social capital hypotheses). Essential economic resources are capital, commodities and energy. Corporations offering these resources are expected to be in the centre of the network. Further on, we expect a hegemonic figuration of central actors "referring" back to themselves..

METHODS

For analysing the cohesion at the aggregate level we will be looking at the change of density of interlocks. Doing this we regard the relations between connected corporations. Density is defined as the proportion of realised to all possible relations (Wasserman et al., 1999). In this case we simply look at single relations between corporations, multiple relations are being neglected. A value close to zero means very little interlocking whereas a value close to the maximum, one (or 100%), is a sign that nearly every actor is connected to every other.
Regarding the network density only may lead to underestimation of cohesion in large networks (Festinger et al., 1950). Therefore, Friedkin measures (Friedkin, 1981) are applied to obtain full complexity of the network cohesion. When comparing networks of different size Friedkin suggests looking at five structural attributes. *Reachability* gives the proportion of mutually connected actors, *geodesic* is the average shortest path between two arbitrary actors, *diameter* is the longest shortest path, and finally the number of triads in the network and the proportion of actors who don't belong to any triad.

The number of ties (defined as *degree*) is a common centrality index for individual actors (Wasserman/Faust, 1999). To point out differences between the corporations degree distributions are compared. Further on, the centrality measure will be generalized to the group level by looking at core-periphery structures (Everett et al., 2005). Core-periphery models are assuming a star alike distribution of ties over the network. In an ideal structure ties centre to a core with high density within, low density between the core and an outer periphery and, hardly any ties within the periphery. The fit of the model is tested by an algorithm correlating the permuted data matrix and the ideal structure matrix (Borgatti et al., 1999).

Stochastic analysis allows us to examine how social capital is distributed by the network. For testing the probabability to observe the given structure we are using exponential random graph (ERG) models based on a Markov Chain Monte Carlo procedure (see Frank et al., 1986; Pattison et al., 1999; Robins et al., 2007; Wasserman et al., 1996. This is a stochastic process creating a random graph with same network size as our observed network. Then, observed and randomized patterns are tested against each other. Thereby, the distinguishing structural attributes of the network (compared to the core) are identified.

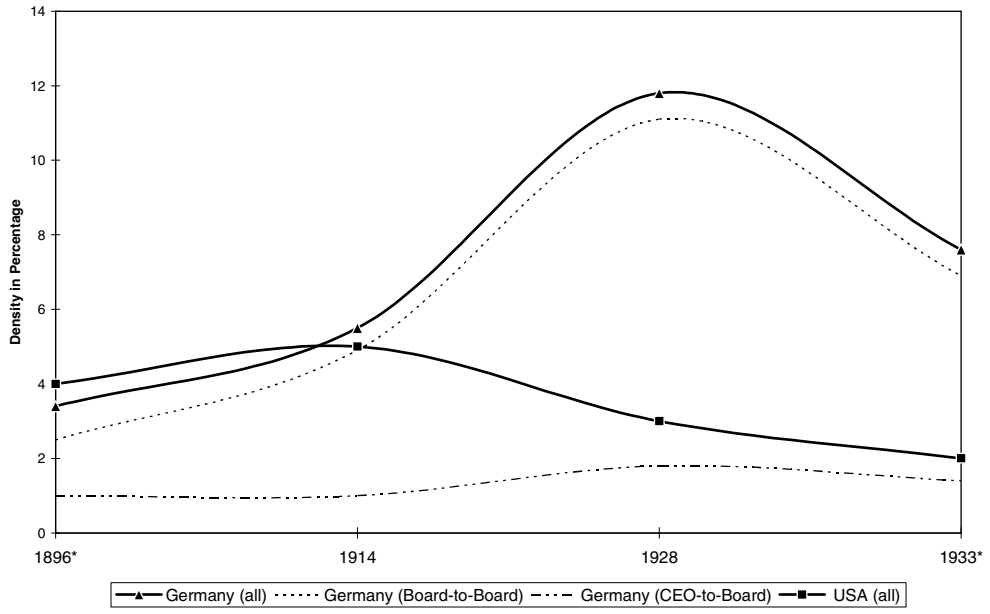
Explanations for the core-periphery structure are further analysed by regression analyses. Depend variable is the core affiliation. Independent variables are the industrial affiliation (by sector), size of the corporation in total balance sheets and the board size (number of CEOS/number of directors on board/number of banks on board of directors). We chose logit regressions for categorical dependent variables (Agresti, 2002).

Software packages used are UCINET, R, PNET and STATA.

RESULTS

Figure 1 compares single relation interlocks of stock companies between Germany and the US at four time points (1896 to 1933). The density of personal interlocks between corporations is in absolute terms not extremely high. It shows that interlocking patterns are in both countries quite similar till 1914. Specific for the German network is a continuous increase of board-to-board relations till 1928. Subsequently, in 1928 the gap in network density is already pronounced. Whereas in the US interlocks between corporations become less likely we are observing a radical proliferation of ties in Germany. By 1933 there is again a decrease in density. This is mainly due to a legal restriction limiting the board size radically.

Moreover, figure 1 shows that in Germany undirected board-to-board relations are much denser than CEO-to-board relations. That is to say, corporations are more likely to be connected by their boards than by their CEOs.



* US: 1900 and 1938

Figure 1: Single Interlocks between Stock Companies in Germany and the US (density in %)

In addition, Friedkin measures give a broader view on network cohesion. Table 2 sums up the results. As we see till 1928 the network gets more connective, path distances between actors decrease, actors are more and more present in cohesive subgroups as triads - even in spite of a boost in network size.

	1896 (N=156)	**1914 (N=321)**	**1928 (N=365)**	**1933 (N=388)**
Connectivity	72.8 %	96.3 %	100 %	100 %
Average Geodesic	3.5	2.7	2.1	2.3
Diameter	9.0	7.0	4.0	5.0
Actors not involved in triads* %	31.4 %	13.1 %	2.2 %	4.4 %
Average number of triads*	7.65	114.65	680.93	254.25
Density	3.4%	5.5%	11.8%	7.6%

* Calculated on the basis of all single relations independent of direction.

Table 2: Network Cohesion (Friedkin Measures)

Looking at cohesion measures we come to the conclusion that the aggregation of personal interlocks between large stock companies is mainly due to processes taking place between 1913 and 1928. Apart from increase in density we observe a fully connected network, short average path distances, a high number of triads and high proportion of actors involved in triads. That confirms our first hypothesis. After the destabilization caused by World War I and the following inflation period the German path logic which encourages the regulation of competition is freezing in the main economic sub spheres. In the US the situation is completely another. Differences in governance traditions give profound explanation for this phenomenon. Central for Germany is the high concentration of corporate ownership in the hand of corporations, personal interlocks have clear incentives as they often go along with capital interlocks (Windolf/Beyer 1995). One could argue that an increase in interlocking is not a big surprise, then, if parent companies staff the board of their (newly acquired) subsidiaries with own directors. And clearly there a several good examples for that amongst which the merger of leading steel and mining companies to the 'Vereinigten Stahlwerke' in 1926 is most prominent. This specific arrangement was considered and discussed by the leading economic figures as August Thyssen und Hugo Stinnes over more than two decades. In the course of the merger the new and extremely large parent corporation became a key actor in the network. So what is interesting about these results? Dispatching of directors to boards of other corporations leads to an increase in directed interlocks. And, yes, indeed, there's a remarkable increase of CEO-to-board relations from 1913 to 1928, e.g. between those corporation forming the 'Vereinigten Stahlwerke'. Nevertheless, even in 1928 directed relations only make 11 percent out of more than 12.000 interlocks. The vast majority of increase in interlocking is due to board-to-board relations. Table 3 gives totals for all four time points.

	Board-Board	**Board-Board (dichot.)**	**multiple***	**CEO-Board**	**CEO-Board (dichot.)**	**multiple***	**reciprocal°**	**Connected Corporations (N)**
1896	377	313	17.%	136	129	5.1%	1%	156
1914	3219	2530	21.4%	543	497	8.5%	1.5%	321
1928	10862	7344	32.4%	1385	1182	14.7%	6.1%	365
1933	6924	5177	25.2%	1219	1026	15.8%	5%	388

* Proportion of multiple relations in total
° Reciprocity is calculated for directed (CEO-Board) relations only.

Table 3: Observed Interlocks 1896-1933

Apart from an overall proliferation in interlocks the main characteristic of the observed network is the increase in "strong ties" (Granovetter, 1973; Uzzi, 1997). We observe a growth of multiple relations in undirected as well as directed board relations. Strong ties like these are not only a sign for an overall concentration process but indicating an opportunity structure for the exchange of valuable information and trust. Directed ties are less likely to observe than undirected ties, nevertheless, they double from 1914 to 1928. From 1928 on also mutual CEO-to-board relations become more common. Thus, the opportunity structure for mutual control increases.

With regard to the distribution of ties Gini-coefficients vary between 1896 and 1933 from 0.46 to 0.53 which is indicating a rather high inequality. Looking at the tie distribution by histograms (here exemplary for 1928) it shows that most corporations have just a few ties to others whereas a small group of corporations gathers the majority of ties (concerning the Matthew effect we refer to Merton, 1968). This is true for undirected relations (figure in the left) and even more for directed relations (figure in the right).

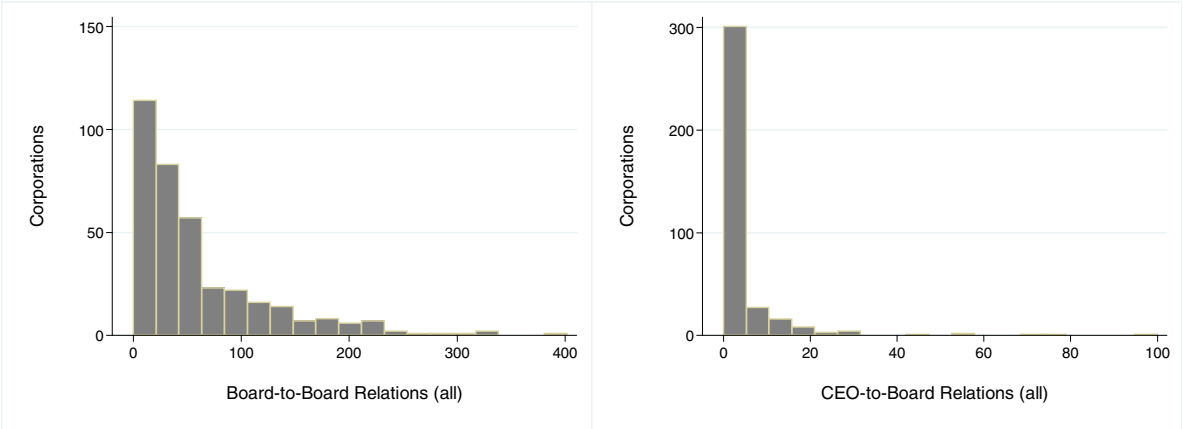


Figure 2: Degree Distribution 1928

A main structural explanation for the inequality in degree distribution is the existence of two complementary regions in the network. By looking at regional differences the centrality concept is generalized to the group level (Everett et al., 2005). Pointing to the network size we assume a core-periphery structure.

When looking at single and multiple relations altogether the observed patterns fit a core-periphery structure. A rather small core (fluctuating between 14% and 19% of all corporations) concentrates most interlocks on itself (s. table 4). E.g. in 1928 the 68 core corporations have more ties than the periphery (297 corporations) altogether and an average number of 185 ties.

	1896 (N=156)	**1914** (N=321)	**1928** (N=365)	**1933** (N=388)
Core	182 /18.2	3507/81.6	12564/184.8	7215/109.3
	(N=10)	(N=43)	(N=68)	(N=66)
Periphery	836/5.7	3981/14.3	11762/39.6	8941/27.8
	(N=146)	(N=278)	(N=297)	(N=322)

Note: In this case we are looking at ties. Every interlock is counted for each corporation. This leads to double counting. In order to avoid double-counting of core-periphery interlocks themselves total shares may not be calculated.

Table 4: Core-Periphery Structure by Ties (Sum /Average)

Moreover the density within the core is much higher than between core and periphery, resp. within the periphery (s. table 5).

	1896		**1914**		**1928**		**1933**	
	C (N=10)	**P** (N=146)	**C** (N=43)	**P** (N=278)	**C** (N=68)	**P** (N=297)	**C** (N=66)	**P** (N=322)
Core	1,489	0,033	1,082	0,130	1,680	0,243	0,942	0,149
Periphery	0,033	0,037	0,130	0,032	0,243	0,078	0,149	0,056

Table 5: Core-Periphery Structure by Density (sum of relations)

In addition, the core-periphery structure is mostly due to multiple relations. Looking at single relations only the differences in density are much lower (s. table 6). That leads to the conclusion that the core nourishes itself from multiple, therefore, rather strong interlocks.

	1896		**1914**		**1928**		**1933**	
	C (N= 10)	**P** (N=146)	**C** (N=87)	**P** (N=234)	**C** (N=119)	**P** (N=246)	**C** (N=123)	**P** (N=265)
Core	0,733	0,053	0,351	0,049	0,520	0,104	0,320	0,070
Periphery	0,053	0,028	0,049	0,019	0,104	0,037	0,070	0,029

Table 6: Core-Periphery Structure by Density (single relationsl)

Resuming results so far, the observed network is shaped by a minority of corporations with not only comparatively more but also multiple interlocks. These actors gain a high amount of social capital out of this network. There is reason to assume that the core chooses preferably back to itself. Multiple ties prove the strength of relations. But what do we know about reciprocal ties? From what we see we would expect much reciprocity within the core.

Reciprocity is a universal characteristic of social relations. It can only be traced for ties with “directions”, in our case, CEO-to-board relations. The other social force analysed here is preferential attachment (Barabasi et al., 1999). For directed ties the later has two different information. Expansiveness of an actor k is identified via a k-out-star structure (much "sending"). Respectively, popularity of an actor is identified via k-in-star structure (much “receiving"). Both forces are modelling the Matthew effect in distribution of ties (Merton 1968). To

analyse the corresponding social forces behind the patterns of observed interlocks we proceed with random graph analysis.[2] Accounting for the shortness of the paper, we focus on 1914 and 1928.

When comparing dyadic attributes to a random distribution in a network of same size and density we observe three main results.[3]. For two chosen time points there's more reciprocity than expected. That's the strongest effect. With regard to preferential attachment, expansiveness and popularity are clearly forces driving the network. We observe a k-out star as well as a k-in star effect.

	1914				**1928**			
	Full Network (N= 321)		**Core** (N= 43)		**Full Network** (N=365)		**Core** (N= 68)	
Effects	*obs.*	*est. Parameter*	*obs.*	*est. Parameter*	*obs.*	*est. Parameter*	*obs.*	*est. Parameter*
Reciprocity	*18*	*2.85**	*11*	*0.97**	*83*	*2.7**	*21*	*1.03**
K-out-Star	*661*	model 1 *(2.17*)* model 2	*199*	*2.57**	*1752*	*2.27**	*430*	*2.29**
K-in-Star	*432*	*(0.99*)* model 2	*138*	*0.66**	*1385*	*1.02**	*338*	*0.27**

* Significant at 0.01 level
Note: Parameter values infer that the corresponding configuration is present in the observed graph to a greater or lesser extent than expected by chance.

Table 7: ERG Estimation for CEO-to-Board Relations (final model with fixed density)

By checking forces driving the full network against the core we come to a surprising result. The reciprocity effect is distinctly smaller for the later. Reciprocity is less likely within the core than in the full network. As well as core interlocks are less likely to have a k-in-star structure than the network as a hole. Nevertheless, the core is quite expansive. Seeing both results together there's reason to assume that CEOs of core corporations tend to span directed ties to the periphery. But what role does the core take with it? And what else do we know about core corporations?

Our final examination might suggest some possible answers. We close with regression analysis based on social capital assumptions. Actor attributes are tested as explanatory factors for core affiliation. Resource dependence theories suggest an influence by sector (model 1). Control variables are size of corporations (by balance sheet totals) and board sizes (model 2). Because of the prominence of finance control models we are not only looking at the banking sector but also including the personal level, the number of bankers on board of directors.

With respect to determinants for core affiliation models 1 show significant sector effects both for 1914 and 1928. Nevertheless, resource dependence has only little explanation value. However, the fit of the models is highly increasing taking control variables into account. Foremost, the size of board of directors (not CEOs, though) and the number of bankers on board are a key explanatory factor for core affiliation (models 2). [4]

[2] ERG modelling is still developing (problems: easily degenerating, only for single relations). Models only converged for directed CEO-to-board relations without attributes. For that reason the chosen focus is also a technical compromise.
[3] With regard to triadic structures in the network the results didn't suggest any remarkable differences to random networks of the same size. Hence, observed social forces are rather of dyadic than triadic nature.
[4] The size of the board and the number of bankers on board are most influential determinants for the degree distribution as well (concerning results we refer to Krenn, 2008a; Windolf, 2007).

	Core (yes/no)			
	1914		1928	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Sector [++]				
Banking	1.031**	-2.163**	0.739*	0.020
Steel/Metal	1.086**	0.960	1.506***	1.858***
Mining	0.951*	0.527	1.170***	1.276**
Electric utilities	2.049***	2.062**	0.562	0.354
Größe:		1.850		0.034
Balance sheet total (in 100m. Reichsmark)				
Directors (N):		0.088		-0.003
CEOs				
Board Members		0.248***		0.097***
Bankers on Board		1.093***		0.838***
Interactioneffect (Board*Bankers on Board)		-0.034		-0.013**
Constant	-2.386***	-6.289***	-2.003***	-4.868***
Observations	283	283	361	361
Pseudo-R^2	0.06	0.45	0.05	0.33
McFaddens R^2	0.02	0.36	0.02	0.27
Nagelkerkes R^2	0.09	0.55	0.07	0.44
df	4	9	4	9
LR chi2(df)	13.60	102.10	16.67	114.30
Prob > chi2	0.009	0.000	0.002	0.000

* significant at 10%; ** significant at 5%; *** significant at 1%
[++] Category of reference: all other sectors

Table 8: Determinants for Core Affiliation in 1914 and 1928 (logit coefficients)

Remarkably, these models would suggest that the network position is independent from primary resources. The message is clear, co-optation strategies determine the amount of social capital gained by the network. But that's not the whole story. Even, if economically important banks are not securing their core position as group, bankers on board of directors provide corporations with essential links.

CONCLUSION

What does all this mean? To start with, the findings on the macro-level go well along with our hypotheses. The proliferation of interlocks in the 1920s proves the interpenetration of institutions down path dependent argumentation. The establishment of a dense network takes place in a time in which prior selections in law traditions and social organisation already favour or facilitate continuity.

On the individual level however, results are trickier to interpret. Inequality in degree distribution is leading to a core-periphery structure. Hence, the core consists of small group of corporations with diverse structural characteristics. It has strong but rather undirected interlocks within which can be traced back to "network sensitive" directors on boards. Further on, core corporations make use of intentional links by dispatching their CEOs. Especially, there's a high chance for reciprocity between core and periphery. Resuming, core corporations have not only high but moreover quite diverse social capital at disposal. The information flow is secured by a large quantity of undirected interlocks, independently, control opportunities are guaranteed be direct links.

We argued that core corporations are clearly the winner of this specific degree distribution. Nevertheless, this is not due to their hegemonic position which cannot be directly transformed into a power closure, but due to their most effective balance between weak and strong ties.

REFERENCES

1. Abelshauser, W. (2005) Die Wirtschaft des deutschen Kaiserreichs. Ein Treibhaus nachindustrieller Institutionen, in: *Finanzmarktkapitalismus. Analysen zum Wandel von Produktionsregimen (KZfSS Sonderheft 45),* Paul Windolf (Ed.), Wiesbaden, VS Verlag für Sozialwissenschaften, 172-195.
2. Agresti, A. (2002) *Categorical Data Analysis*, (2 ed.), Hoboken/New Jersey, Wiley - Interscience.
3. Barabasi, A.-L., and Albert, R. (1999) Emergence of Scaling in Random Networks, *Science* (286), 509-512.
4. Beyer, J. (2006) *Pfadabhängigkeit. Über institutionelle Kontinuität, anfällige Stabilität und fundamentalen Wandel*, Frankfurt a.M., Campus Verlag.
5. Borgatti, S. P., and Everett, M. G. (1999) Models of core/periphery structures, *Social Networks* (21), 375-395.
6. Bourdieu, P. (1983) Ökonomisches Kapital, kulturelles Kapital, soziales Kapital, in: *Soziale Ungleichheit,* Reinhard Kreckel (Ed.), Göttingen, Vandenhoeck&Ruprecht, 183-198.
7. Coleman, J. S. (1990) *Foundations of Social Theory*, Cambridge/Mass., Harvard University Press.
8. Everett, M. G., and Borgatti, S. P. (2005) Extending Centrality, in: *Models and Methods in Social Network Analysis,* Peter J. Carrington, John Scott and Stanley Wasserman (Eds.), New York, Cambridge University Press, 57-76.
9. Festinger, L., Schachter, S., and Back, K. (1950) *Social Pressure in Internal Groups*, New York, Harper.
10. Frank, O., and Strauss, D. (1986) Markov Graphs, *Journal of the American Statistical Association* (81), 832-842.
11. Freeman, L. C. (2005) Graphic Techniques for Exploring Social Network Data, in: *Models and Methods in Social Network Analysis,* Peter J. Carrington, John Scott and Stanley Wassermann (Eds.), Cambridge, Cambridge University Press, 248-269.
12. Friedkin, N. E. (1981) The development of structure in random networks: An analysis of the effects of increasing network density on five measures of structure, *Social Networks* (3), 41-52.
13. Granovetter, M. (1973) The strength of weak ties, *American Journal of Sociology* (78), 1360-1380.
14. Granovetter, M. (1985) Economic action and social structure. the problem of embeddedness, *American Journal of Sociology* (91), 481-510.
15. Hall, P. A., and Soskice, D. (2001) An Introduction to Varieties of Capitalism, in: *Varieties of Capitalism. The Institutional Foundations of Comparative Advantage,* Peter A. Hall and David Soskice (Eds.), Oxford, Oxford University Press, 1-68.
16. Hilferding, R. (1910) *Das Finanzkapital*, Wien, Ignaz Brand & Co.
17. Hoppenstedt (1896) *Handbuch der deutschen Aktiengesellschaften*, Darmstadt, Hoppenstedt Verlag.
18. Hoppenstedt (1914) *Handbuch der deutschen Aktiengesellschaften*, Darmstadt, Hoppenstedt Verlag.
19. Hoppenstedt (1929) *Handbuch der deutschen Aktiengesellschaften*, Darmstadt, Hoppenstedt Verlag.
20. Hoppenstedt (1934) *Handbuch der deutschen Aktiengesellschaften*, Darmstadt, Hoppenstedt Verlag.
21. Koenig, T., Gogel, R., and Sonquist, J. (1979) Models of the Significance of Interlocking Corporate Directorates, *American Journal of Economics and Sociology* (38), 173-186.
22. Krenn, K. (2008a) *Personelle Unternehmensverflechtung von 1896 bis 1933. Bank-Industrie Netzwerke als deutsche Modernisierungsvariante*, PhD (forthcoming).
23. Krenn, K. (2008b) Von der «Macht der Banken» zur Leitidee des deutschen Produktionsregimes. Bank-Industrie Verflechtung am Beginn des 20. Jahrhunderts, *Zeitschrift für Unternehmensgeschichte*, (53),70-99.
24. Lehmbruch, G. (2001) The Institutional Embedding of Market Economics. The German 'Model' and its Impact on Japan, in: *The Origins of Nonliberal Capitalism. Germany and Japan in Comparison,* Wolfgang Streeck and Kozo Yamamura (Eds.), Ithaca/London, Cornell University Press.
25. Luhmann, N. (1991[4]) Evolution und Geschichte, in: *Soziologische Aufklärung 2. Aufsätze zur Theorie der Gesellschaft,* Niklas Luhmann (Ed.), Opladen, Westdeutscher Verlag, 150-169.
26. Merton, Robert K., 1968, The Matthew effect in Science, *Science* (159), 56-63.
27. Mizruchi, M. (1996) What Do Interlocks Do? An Analysis, Critique, and Assessment on Interlocking Directorates, *Annual Review of Sociology* (22), 271-298.
28. N.N. (1900/01a) *Moody's Manual of Railroads and Corporation Securities*, New York, Poor's Publishing Co.
29. N.N. (1900/01b) *Poor's Manual of Industrials*, New York, Poor's Railroad Manual Co.
30. N.N. (1901) *The Manual of Statistics (Stock Exchange Hand-Book)*, New York, The Manual of Statistics Co.
31. N.N. (1914/15a) *Moody's Manual of Railroads and Corporation Securities*, New York, Poor's Publishing Co.
32. N.N. (1914/15b) *Poor's Manual of Industrials*, New York, Poor's Publishing Co.

33. N.N. (1915) *The Manual of Statistics (Stock Exchange Hand-Book)*, New York, The Manual of Statistics Co.
34. N.N. (1928/29a) *Moody's Manual of Railroads and Corporation Securities*, New York, Poor's Publishing Co.
35. N.N. (1928/29b) *Poor's Manual of Industrials*, New York, Poor's Publishing Co.
36. North, D. C. (1990) *Institutions, Institutional Change and Economic Performance*, Cambridge, Cambridge University Press.
37. Pattison, P., and Wasserman, S. (1999) Logit models and logistic regressions for social networks. II. Multivariate relations, *British Journal of Mathematical and Statistical Psychology* (52), 169-194.
38. Polanyi, K. (1944) *The Great Transformation*, Boston, Beacon Press.
39. Robins, G., Pattison, P., Kalish, Y., and Lusher, D. (2007) An introduction to exponential random graph (p*) models for social networks, *Social Networks* (29), 173-191.
40. Streeck, W., and Höpner, M. (Eds.) (2003) *Alle Macht dem Markt? Fallstudien zur Abwicklung der Deutschland AG*, Frankfurt a.M. Campus Verlag.
41. Streeck, W., and Yamamura, K. (Eds.) (2001) *The Origins of Nonliberal Capitalism. Germany and Japan in Comparison*, Ithaca und London Cornell University Press.
42. Thelen, K. (2003) How Institutions Evolve. Insights from Comparative Historical Analysis, in: *Comparative Historical Analysis in the Social Sciences,* James Mahoney and Dietrich Rueschemeyer (Eds.), Cambridge, Cambridge University Press, 208-240.
43. Uzzi, B. (1997) Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness*, Administrative Science Quarterly* (42), 35-67.
44. Wasserman, S., and Faust, K. (1999) *Social Network Analysis. Methods and Applications*, New York, Cambridge University Press.
45. Wasserman, S., and Pattison, P. (1996) Logit Models and Logistic Regressions for Social Networks: I. An Introduction to Markov Graphs and p*, *Psychometrika* (61), 401-425.
46. Windolf, P. (2002) *Corporate Networks in Europe and the United States*, New York, Oxford University Press.
47. Windolf, P. (2006) Unternehmensverflechtungen im organisierten Kapitalismus, *Zeitschrift für Unternehmensgeschichte* (51/2), 191-222.
48. Windolf, P. (2007) Sozialkapital und soziale Ungleichheit. Vergleichende Analysen zur Unternehmensverflechtung in Deutschland und in den USA (1896-1938), *Jahrbuch für Wirtschaftsgeschichte* (2), 197-230.
49. Windolf, P., and Beyer, J. (1995) Kooperativer Kapitalismus - Unternehmensverflechtungen im internationalen Vergleich, *Kölner Zeitschrift für Soziologie und Sozialpsychologie* (47), 1-36.